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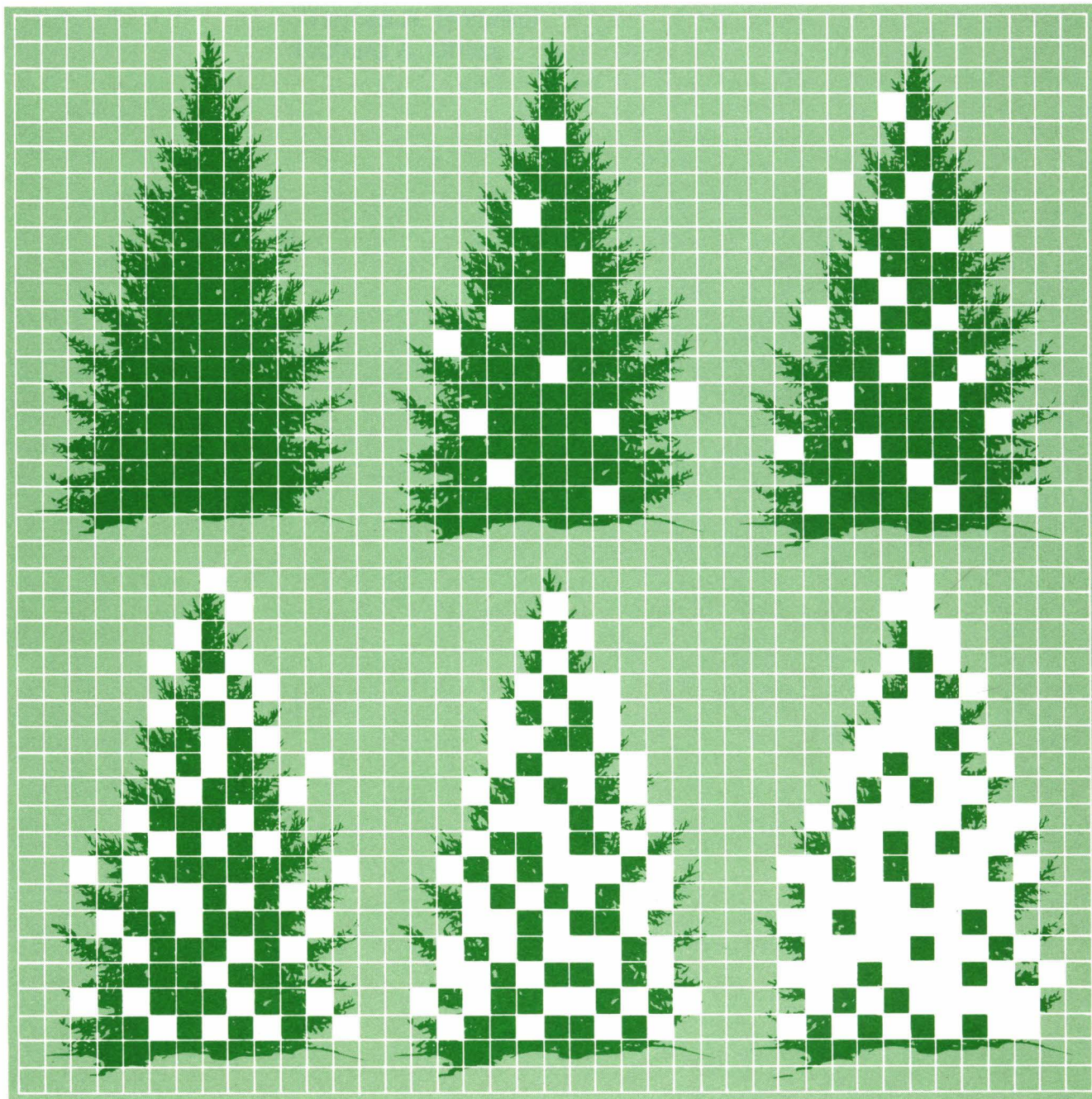
Forest Pest
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Washington, D.C.

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An Economic Analysis of Forest Pest Management Program Activities



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An Economic Analysis of Forest Pest Management Program Activities

The Efficiency of Changes in FPM Program Funding

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SUMMARY

This analysis evaluates the economic efficiency of additional increments to the non-suppression portion of the Forest Pest Management(FPM) program. The effects of potential FPM activities on resource management objectives are analyzed and an economically optimal program increase is determined. The analysis does not address the existing (base) program, but it does provide a methodology that can be used to determine the optimal funding level for the total non-suppression program (base program + increment). The total non-suppression program will be analyzed in the near future.

To evaluate changes in the non-suppression portion of the FPM program, incremental funding increases were allocated to all Forest Service Regions, but one. Region 10 was excluded because the existing program level in that Region is considered to be about right. The Regions chose individual program activities that would be funded by the increased allocation. Next, production functions (explained on pages 4-5) were developed to relate the additional dollar inputs to resource and dollar outputs. The economic efficiency of each program activity was then calculated and all activities with Benefit/Cost (B/C) ratios greater than 1 were added together. The total cost to implement these activities constitutes the economically optimal program increase.

Of the 69 program activities evaluated, 81 percent (56 activities) had B/C ratios greater than 1. Ratios ranged from a high of approximately 74 to 1, to a low of 0 to 1. Most B/C ratios fell between 1 to 1 and 5 to 1. A 4 percent real discount rate was used in the analysis.

The economically optimal change in the FPM program occurs at a budget increase of approximately \$5.5 million (a 60 percent increase over the 1987 program budget for non-suppression activities). This increased expenditure would produce benefits valued at approximately \$25 million, resulting in a Present Net Value (PNV) of approximately \$19.5 million.

The analysis indicates that significant efficiencies can be gained by increasing the non-suppression portion of the FPM program.

INTRODUCTION

The purpose of this analysis is to determine the level of Forest Pest Management (FPM) expenditures that would be an efficient addition to current Forest Pest Management program activities.

Forest pest management activities are separated into two major categories:

1. Suppression of individual insect or disease outbreaks.
2. A recurring, non-suppression, program that includes activities such as conducting detection surveys, evaluating pest problems, and providing technical assistance.

The economics of suppressing individual outbreaks is routinely analyzed on a case by case basis. The analyses are relatively straightforward because a specific infestation in a defined area of forest land is involved. The suppression costs are known for the defined area, and the pest impacts can be predicted using computerized models or data from previous epidemics. Moreover, for a particular year, the economically optimal level of FPM suppression expenditures can be estimated by totalling the costs for all suppression projects having a benefit/cost ratio greater than 1.0).

Determining the efficient level of additional expenditures for non-suppression program activities is a difficult process. For example, technical assistance activities are not directly tied to a specific outbreak on an identified portion of land, and most non-suppression activities are only indirectly related to mitigating pest impacts. Nevertheless, this analysis examines the economic efficiency of proposed changes in the non-suppression portion of the FPM program. The analysis identifies potential FPM program activities, describes the effects of these activities on resource management objectives, and quantifies the benefits attributable to these activities.

To evaluate changes in the non-suppression portion of the FPM program, FPM Staff Directors in each Forest Service Region (except Region 10) identified individual program activities that would be undertaken if additional funds were available. FPM specialists developed production functions to relate the additional dollar inputs to resource and dollar outputs (see pages 4-5 for a detailed explanation of a production function). The economic efficiency of the individual program activities was calculated and activities with B/C ratios of 1.0 or better were added together to determine the economically optimal program change. The intent of the analysis was to assess the economic efficiency of broad program changes, not to compare specific activities to one another.

STUDY ORGANIZATION

To analyze the economic efficiency of changes in the FPM program, a study group was structured to include a Steering Committee, a Core Team, a Technical Support Group, and seven Pest Analysis Teams. The Steering Committee determined the study objectives and scope of the analysis. The Core Team directed the analysis and guided development of the production functions. The Technical Support Group provided technical and computer assistance to the Core Team. The seven analysis teams were formed to provide technical expertise on all insects and diseases, nationwide, and consisted of specialists who have in-depth knowledge of the major pests represented by each team. These teams were responsible for describing and quantifying the effects of additional FPM program activities on forest resource outputs. This was done by developing production functions for all program activities related to their area of pest expertise, regardless of geographic region.

The Study Group was structured as follows:

Steering Committee

J. Space, Director, FPM
K. Knauer, Assistant Director, FPM
M. Ollieu, Assistant Director, FPM

Core Team

J. Lewis, Economist
T. Hofacker, Entomologist
R. Chase, Planning Specialist

Technical Support Group

W. Ciesla, Entomologist
B. Eav, Oper.Res.Analyst
M. Bellinger, Economist

Analysis Team 1 (eastern defoliators)

D. Souto, Entomologist
D. Twardus, Entomologist

Analysis Team 2 (eastern bark beetles / other eastern insects)

K. Swain, Entomologist
M. Connor, Entomologist

Analysis Team 3 (eastern diseases)

D. Brown, Pathologist
R. Anderson, Pathologist

Analysis Team 4 (western bark beetles)

D. Holland, Entomologist
G. Lessard, Entomologist

Analysis Team 5 (western defoliators / other western insects)

B. Hostetler, Entomologist
W. Bousfield, Entomologist

Analysis Team 6 (western diseases)

J. Kliejunas, Pathologist
J. Beatty, Pathologist

Analysis Team 7 (unwanted vegetation)

L. Gross, Pesticide Specialist
M. Williamson, Pesticide Specialist

PROGRAM CATEGORIES

For purposes of this analysis, the recurring FPM program activities were divided into the following four broad categories:

- *Detection / Evaluation* included surveillance and planned surveys to discover, identify, and report pest outbreaks. Also included in this category were the gathering, analysis, and interpretation of technical data to provide a sound basis for making resource management decisions.
- *Technical Assistance / Technology Transfer* included the provision of special advice through training and direct assistance in pest management aspects of resource management and related activities. Also included in this category was the transfer of available pest management-related technological developments to the appropriate users.
- *Technology Development* included the development of new pest management-related techniques, concepts, and equipment to improve the efficiency and effectiveness of managing forest pests.
- *Prevention* included activities, other than technical assistance, designed to minimize the impact of a pest before an outbreak occurs, silvicultural activities carried out to increase tree vigor or otherwise reduce losses or stand susceptibility to pest damage, and activities designed to protect high-value resources from imminent pest attack.

All specific program activities in this analysis were assigned to one or more of the preceding categories.

BUDGET ALLOCATIONS

To begin the analysis, FPM Staff Directors in each Forest Service Region (except Region 10) were asked what kind of program changes they would

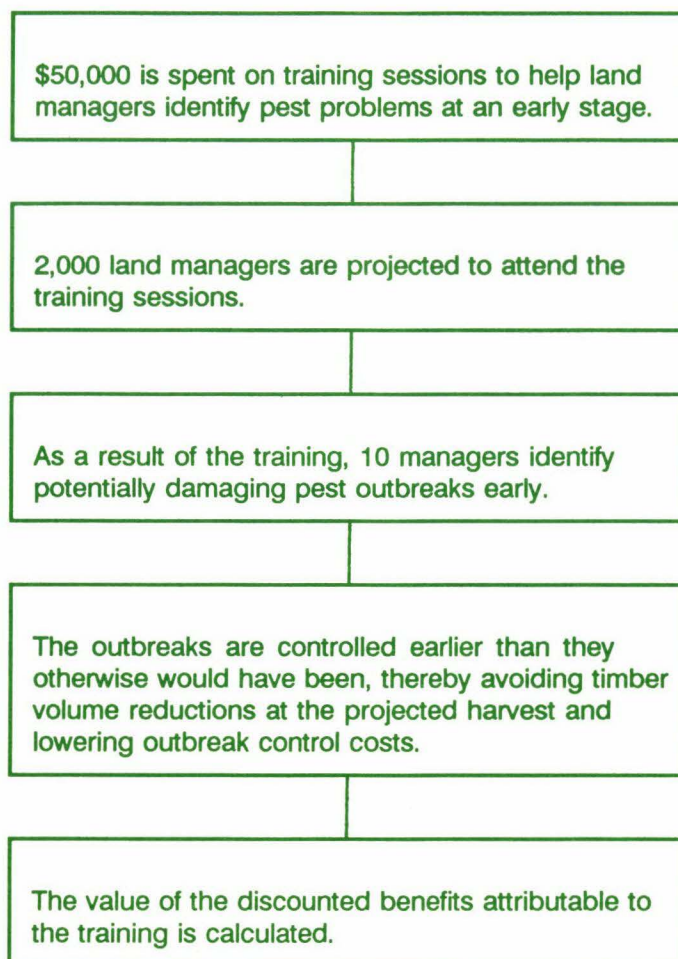
make at each level if they were to receive funding increases of 20, 40, 60, and 100 percent. They filled out forms allocating the additional funds, by pest, among the four program activity categories. These allocations served as the basis for developing production functions to describe the effects of changes in the FPM program on forest management objectives. The economic analysis was then conducted to determine which program changes were economically efficient.

PRODUCTION FUNCTIONS

A production function is a description of the input/output relationships of a particular program activity. As used in this study, the production function described the events that would take place after an additional expenditure of FPM funds, and also the benefits that would accrue as a result of the expenditure. A typical production function in this study contained the following information:

- *Expenditure amount*--The additional funds required to accomplish a particular program activity.
- *Activity description*--A description of the intent of the activity and the projected course of events that would occur if the activity takes place.
- *Assumptions and background data*--All pertinent assumptions and data necessary to determine the physical and economic effects of the program activity.
- *Economic calculations* -- A series of cash flows that occur over time with and without the program activity. Present Net Value (PNV) was computed for both the "with" and "without" scenarios. The difference in PNV's with and without the program activity was the net benefit of the activity. The benefit cost (B/C) ratio of the activity was the net benefit divided by the cost of the activity. The PNV of the activity was the net benefit minus the cost of the activity.

A general example of a production function is as follows:



Production functions were developed by the Pest Analysis Teams with assistance from the Core Team. Each production function is a separate analysis in and of itself. As such, each contains its own assumptions, background data, and economic calculations. There were 69 separate production functions developed for this analysis. Appendix A contains 3 examples of production functions.

ECONOMIC EFFICIENCY

This analysis determined the economic efficiency of additional increments to the FPM program. An additional increment may relate to a specific program activity for a specific pest in a specific geographic area (e.g. integrating fusiform rust considerations into the forest planning process on National Forests in the South), or it may relate to a very general program activity (e.g. establishing a new field office to increase technical assistance on forest pests to all landowners in a given area).

Each program increment had an associated production function which described the program activity in detail and calculated the PNV and B/C ratio for that activity. The program activities were ranked by B/C ratio in descending order to determine the economically optimal level of change in the FPM program. The economically optimal change in the FPM program was the cumulative total of all program increments having B/C ratios greater than 1. Beyond this level, the benefits of additional program activities did not exceed the additional costs.

ASSUMPTIONS AND BACKGROUND DATA

Since each production function constituted an economic analysis in and of itself, each contained its own assumptions and data. However, some general assumptions and data were applicable to all production functions:

All benefits were expressed in marginal terms (i.e. benefits were calculated as the difference in cash flows with and without the program activity);

All future costs and revenues were discounted at a real rate of 4 percent;

No real price increases were used;

All program activity impacts were evaluated within the context of forest resource management objectives; and

Resource prices and program costs were based on regional and local information.

RESULTS

For the 69 program activities evaluated, B/C ratios ranged from a high of approximately 74 to 1, to a low of 0 to 1, with most falling between 1 to 1 and 5 to 1.

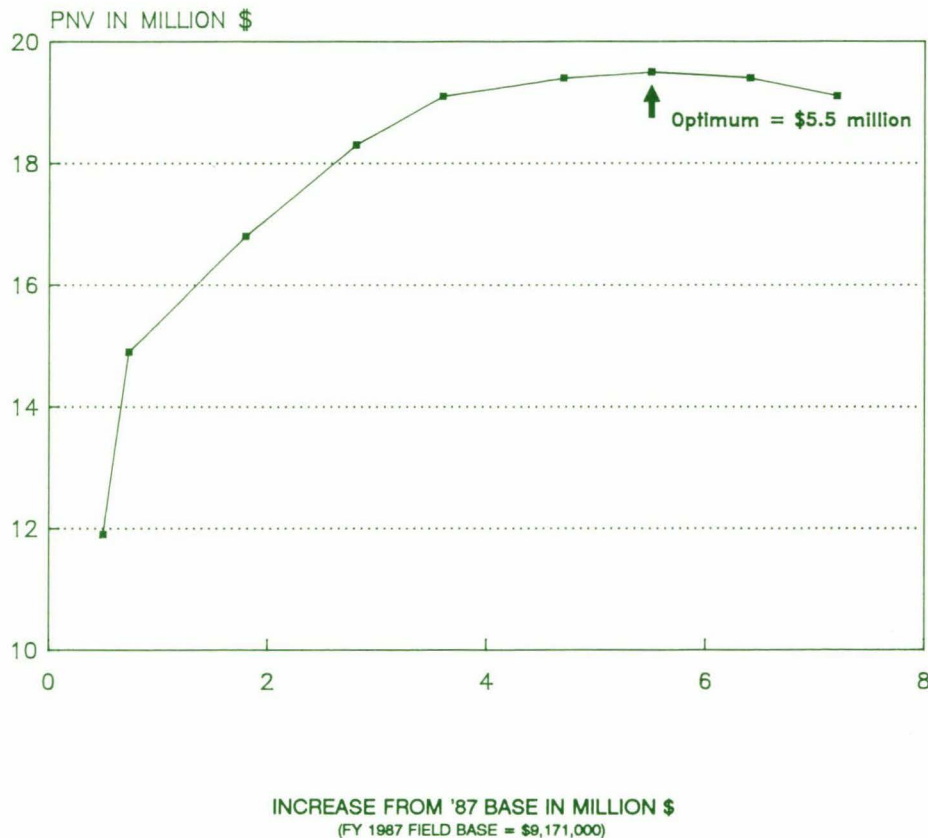
Fifty-six (81 percent) of the program activities had B/C ratios greater than 1; thirteen (19 percent) had B/C ratios less than 1; and thirteen (19 percent) had B/C ratios greater than 5.

The approximate cost to implement all 56 activities with B/C ratios greater than 1 would be \$5.5 million (in 1987 dollars).

As shown in figure 1, \$5.5 million would be the economically optimal change in the non-suppression portion of the FPM program. This increased expenditure would produce discounted marginal benefits valued at approximately \$25 million and result in a marginal PNV of approximately \$19.5 million.

In fiscal year 1988, FPM program expenditures will increase by \$1.6 million. This analysis, along with other information, will be used to decide how this budget increase will be allocated.

Figure 1—PRESENT NET VALUE OF PROGRAM CHANGES



CONCLUSION

This analysis shows that an additional \$5.5 million would be the economically optimal change in FPM non-suppression program funding (a 60 percent increase over the 1987 program budget for field activities). This \$5.5 million increment would produce about \$25 million in discounted marginal benefits.

Since the fiscal year 1988 appropriation increased FPM program funding for field activities by \$1.6 million, an additional \$3.9 million would be needed to take full advantage of the economic efficiencies that can be achieved by funding additional program activities.

IMPLICATIONS

- This analysis demonstrates that general program activities can be analyzed in a systematic fashion. The analysis provides needed information on the effectiveness and efficiency of potential program changes. The approach used here on a national basis can also be used to assess economic efficiencies within a Region.
- The evaluation approach used here is also appropriate for analyzing the total FPM non-

suppression program (existing program as well as program changes). It is likely that greater efficiencies can be achieved, and inefficiencies eliminated, through an extensive evaluation of the existing FPM program. Such an effort would produce some insights into maximizing the returns on FPM program expenditures and efficiently allocating program funds among Regions. An analysis of the entire non-suppression portion of the FPM program will be initiated in fiscal year 1989 and will take about two years to complete.

- Although this analysis evaluates relatively permanent program changes, it does so from today's perspective. Many factors affecting the analysis are certain to change over time. To keep pace with change, the analysis should be updated periodically (e.g. every 3 to 5 years).
- Accuracy of the production functions varies considerably. In quantifying the physical effects of program activities, some production functions are based primarily on empirical data, while others rely heavily on judgment and/or un-supported data. We need to strengthen our ability to quantify the effectiveness of program activities.

Appendix A

PRODUCTION FUNCTIONS

PEST: *Seed & Cone Insects*

ACTIVITY: *TA/TT*

COST: \$ 60,000

DESCRIPTION: *Intensify Tree Improvement/Seed Orchard Protection*

NARRATIVE: Provide assistance to improve protection of genetically superior trees, test plantations, and seed orchards from insect damage.

ASSUMPTIONS & BACKGROUND DATA:

- Produce 250 lbs. of 15% improved seed with current program.
- Value of 15% improved seed = \$300/lb.
- Control cost under current program = \$2,000/year
- Produce 500 lbs. of 30% improved seed as a result of increased program.
- Value of 30% improved seed = \$700/lb.
- Control cost under increased program = \$8,000/year.
- Seed will be available in 15 years.

CALCULATIONS:

Net annual control cost = \$8,000-\$2,000 = \$6,000

Value of annual production increase = (500lbs.x\$700)-(250x\$300) = \$275,000.

Value of \$275,000 in perpetuity, beginning in year 15 = \$6,875,000

PV of \$6,875,000 discounted 15 years = \$3,817,443.

PV of \$3,817,443 - (\$6,000 in perpetuity, beginning in year 1) = \$3,667,443.

PV of \$60,000 in perpetuity, beginning in year 1 = \$1,500,000.

PNV = \$3,667,443-\$1,500,000 = \$2,167,443

B/C = 2.44

Equivalent Annual Value of \$3,667,443 = \$146,698

Equivalent Annual Value of \$1,500,000 = \$ 60,000

Average Annual PNV = \$146,698 - \$60,000 = \$86,698

PNV: \$86,698

B/C: 2.44

PEST: *Other Western Diseases*

ACTIVITY: *TA/TT*

COST: \$ 40,000

DESCRIPTION: *Increase Pathology Assistance at Humbolt Nursery*

NARRATIVE: Employ 1 pathologist full time at Humbolt Nursery to control Phoma blight, improve present spray schedule, screen new fungicides, and identify disease problems quicker.

ASSUMPTIONS & BACKGROUND DATA:

- Average annual seedling losses at Humbolt Nursery = 3,175,000 seedlings/year.
- Average value of seedlings = \$200/1,000 seedlings.
- Pathologist assistance would reduce losses by 30%.

CALCULATIONS:

Benefits = 3,175,000 seedlings x 0.3 loss reduction x \$200/1,000 seedlings = \$190,500.

Cost = \$40,000

B/C = $\frac{\$190,500}{\$40,000} = 4.76$

PNV = \$190,500 - \$40,000 = \$150,000

PNV: \$150,000

B/C: 4.76

PEST: *Root Disease*

ACTIVITY: *TA/TT*

COST: \$ 80,000

DESCRIPTION: *Influence Prescriptions*

NARRATIVE: Technical assistance will be provided by FPM to incorporate root disease considerations in the development of silvicultural prescriptions on National Forests.

ASSUMPTIONS & BACKGROUND DATA:

- 2,160 acres harvested each year have root diseases.
- FPM input into prescriptions will increase volume harvested by 11.3 MBF per acre at rotation on 1,360 acres.
- Average rotation = 100 years.
- Stumpage price = \$35.00/MBF.

CALCULATIONS:

Benefits = 1,360 acres x 11.3 MBF x \$35 discounted for 100 years at 4% =
\$537,880 = \$10,650
(1.04)¹⁰⁰

PNV: -\$69,350

B/C: .13